

WHAT IS CLAIMED IS:

1. A motor driving device comprising:
a semiconductor switching element interposed in a current
flowing passage to a motor;
- 5 a PWM control unit for generating a PWM signal having a
predetermined PWM frequency;
 a driving circuit for making the semiconductor switching
element carry out a switching operation under plural driving
states, and driving the semiconductor switching element in PWM
10 (Pulse Width Modulation) mode according to the PWM signal under
an instructed driving state;
- 15 an overheat state detecting unit for outputting an overheat
state detecting signal on a condition that a temperature of the
semiconductor switching element exceeds a predetermined
threshold value and the semiconductor switching element falls
into an overheat state or a state in which the probability that
the semiconductor switching element will shift to the overheat
state is higher than a predetermined probability; and
- 20 a driving control unit for instructing the driving state
of the semiconductor switching element to the driving circuit
so that the rise time and fall time of the semiconductor switching
element during an output period of the overheat state detecting
signal are shorter than the rise time and fall time of the
semiconductor switching element during a non-output period of
25 the overheat state detecting signal.

2. The motor driving device according to claim 1, wherein
the driving control unit controls the PWM control unit so that
the PWM frequency during the output period of the overheat state
detecting signal is lower than the PWM frequency during the
5 non-output period of the overheat state detecting signal.

3. The motor driving device according to claim 1, wherein
the driving circuit varies a resistance value of a resistor
connected to the semiconductor switching element on the basis
10 of an instruction from the driving control unit to thereby vary
the rise time and fall time of the semiconductor switching
element.

4. The motor driving device according to claim 1, wherein
15 the overheat state detecting unit includes a temperature
detecting unit for detecting a temperature of the semiconductor
switching element, and outputting the overheat state detecting
signal during a period when the detected temperature exceeds
the threshold value.

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5. The motor driving device according to claim 1, wherein
the overheat state detecting unit includes a current detecting
unit for detecting current flowing in the semiconductor switching
element, and outputting the overheat state detecting signal
25 during a period when the detected current exceeds a predetermined
threshold value.

6 . The motor driving device according to claim 1 , wherein
the overheat state detecting unit includes a power supply voltage
detecting unit for outputting the overheat state detecting signal
5 during a period when a detected power supply voltage exceeds
a predetermined threshold value.

7 . The motor driving device according to claim 1 , wherein
the overheat state detecting unit outputs the overheat state
10 detecting signal during a period when a duty ratio of PWM driving
exceeds a predetermined threshold value.

8 . The motor driving device according to claim 1 , wherein
the overheat state detecting unit outputs an overheat state
15 detecting signal that has two threshold values for an output
judgment of the overheat state detecting signal and is brought
with a hysteresis characteristic.

9 . The motor driving device according to claim 1 , wherein
20 the PWM control unit is equipped with a motor voltage detecting
unit for detecting a voltage applied to the motor , and determines
the duty ratio of the PWM signal on the basis of an instructed
motor voltage and a detected motor voltage.

25 10 . The motor driving device according to claim 1 , wherein
the motor is an air blowing fan motor for a heat exchanger in
a cooling system for a vehicle.

11. The motor driving device according to claim 2, wherein
the PWM frequency during the output period of the overheat state
detecting signal is set to an audible frequency band to thereby
5 provide human perception.

12. The motor driving device according to claim 2, wherein
the driving circuit varies a resistance value of a resistor
connected to the semiconductor switching element on the basis
10 of an instruction from the driving control unit to thereby vary
the rise time and fall time of the semiconductor switching
element.

13. The motor driving device according to claim 12, wherein
15 the overheat state detecting unit includes a temperature
detecting unit for detecting a temperature of the semiconductor
switching element, and outputting the overheat state detecting
signal during a period when the detected temperature exceeds
the threshold value.

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14. The motor driving device according to claim 12, wherein
the overheat state detecting unit includes a current detecting
unit for detecting current flowing in the semiconductor switching
element, and outputting the overheat state detecting signal
25 during a period when the detected current exceeds a predetermined
threshold value.

15. The motor driving device according to claim 12, wherein
the overheat state detecting unit includes a power supply voltage
detecting unit for outputting the overheat state detecting signal
during a period when a detected power supply voltage exceeds
5 a predetermined threshold value.

16. The motor driving device according to claim 12, wherein
the overheat state detecting unit outputs the overheat state
detecting signal during a period when a duty ratio of PWM driving
10 exceeds a predetermined threshold value.

17. The motor driving device according to claim 12, wherein
the PWM control unit is equipped with a motor voltage detecting
unit for detecting a voltage applied to the motor, and determines
15 the duty ratio of the PWM signal on the basis of an instructed
motor voltage and a detected motor voltage.